

The Hood Canal Dissolved Oxygen Program:
Relationship to Clean Water Act Mandates
as implemented by
the United States Environmental Protection Agency
and
Washington State Department of Ecology

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Background

The Hood Canal Dissolved Oxygen Program, comprised of state, federal, tribal, local, and university scientists and other contributors, is undertaking a scientific study to understand the causes of low dissolved oxygen concentrations in Hood Canal.

Managers at U.S. EPA Region X (EPA) and the Department of Ecology (Ecology) desired clarification on whether the current study will be sufficient for them to carry out their mandates under the Clean Water Act, or if additional scientific work is needed. The purpose of this document ~~it~~ **is to** provide that clarification.

What the Hood Canal Dissolved Oxygen Program Will Provide

The Hood Canal Dissolved Oxygen Program consists of a scientific study that examines the dominant and contributing factors affecting Hood Canal dissolved oxygen through the use of a quantitative model. The study is described in detail at <http://www.hoodcanal.washington.edu/>.

The Hood Canal Dissolved Oxygen program has a broad list of participants, including several state (Departments of Ecology, Fish and Wildlife, Health, and Natural Resources, Washington Sea Grant, Puget Sound Action Team), federal (EPA, Corps of Engineers, Fish and Wildlife Service, NOAA, PNNL, USGS, Navy), and local (Conservation Districts, Counties), agencies and academic interests (University of Washington Applied Physics Laboratory and the School of Oceanography) as well as the Hood Canal Coordinating Council and the Lower Hood Canal Watershed Implementation Council.

The study is designed to inform this broad array of management interests. The answers provided will guide management decisions for all of these agencies. However, the study is not designed to necessarily answer every specific management question from each organization.

If a particular organization's question(s) can be relatively easily addressed (for example, an extra model run), that question can likely be answered within the current scope of the HCDOP study. However, if the specific management question requires a significant amount of effort, it would likely require additional funding to the HCDOP, or the organization would need to find an answer some other way.

What EPA and Ecology Need

In general, to carry out their mandate under the Clean Water Act, EPA and Ecology need to know whether the state's water quality standard for dissolved oxygen is being met in Hood Canal, and if not, what would be needed in terms of nitrogen load reductions to do so. Because **dissolved oxygen within Hood Canal under natural conditions would be depressed due to a combination of factors (e.g., limited circulation, great depths, natural productivity, and boundary effects from the ocean)**, ~~the canal is at least partially affected by naturally occurring low dissolved oxygen oceanic water,~~ the answer to this question involves separating natural from human-caused effects. The approach that is usually taken **is the following**:

- 1. Develop a water quality model, based on available data, that captures physical, chemical, and biological processes affecting dissolved oxygen.**
- 2. Estimate current conditions using the model.**
- 3. Estimate the natural condition by removing known anthropogenic sources.**
- 4. Based on spatial and temporal patterns under current and natural conditions, determine location and time of maximum impact.**
- 5. Determine whether current and/or future projected anthropogenic loads cause more than a 0.2 mg/L decrease in dissolved oxygen, compared to natural conditions for the critical condition.**
- 6. If impacts exceeds standards, evaluate relative impact of different source types (e.g., alder conversion vs onsite septs). Identify optional management approaches for reducing anthropogenic sources so that water quality standards are met.**
- ~~7. Through modeling, define the natural nitrogen loading (best estimate) to Hood Canal and the associated dissolved oxygen concentrations (including spatial and temporal patterns).~~
- ~~8. Define the additional loads from anthropogenic sources and their respective effect on dissolved oxygen levels, at the critical condition (place and time).~~

EPA and Ecology also have certain state and federally-mandated requirements related to data quality as well as the need to have highly defensible products that stand up to scientific and legal challenges. These requirements include:

- Water quality data used for management purposes must be collected under a Quality Assurance Project Plan.
- To withstand scientific and legal scrutiny, the final study results need to have documentation of model **assumptions**, performance and uncertainty. The typical process is to first produce a "Model Development and Calibration Report" which is peer-reviewed by the participating organizations (the major elements of such a report are shown in Attachment A). Once the major comments are addressed, the model is used to assess compliance with standards and for running various management scenarios. Upon the completion of this phase, a "Model Application Report" (Attachment A) is prepared, which also undergoes a peer review.
- The model is made available **to the public (e.g., for third-party use for running additional scenarios for external stakeholders)**.

Sufficiency of the Hood Canal Dissolved Oxygen Program for meeting EPA and Ecology Clean Water Act Mandates

The Hood Canal Dissolved Oxygen study will provide information valuable to EPA and Ecology. The information to be provided on the major factors and processes contributing to low dissolved oxygen is of major interest to these agencies.

Because of the QAPP requirement, Ecology took the lead in developing the Year 1 HCDOP QAPP (<http://www.ecy.wa.gov/biblio/0503114.html>).

[Jan, I believe that Mindy is waiting for input from you for the Year 2 QAPP.]

[Jan, could you add some material re: expected documentation and review process for the HCDOP reports?]

[managers are also interested in an estimated time-frame...]

Hood Canal is Unique

Because of **Hood Canal is naturally sensitive to nitrogen inputs, the focus of analysis is somewhat different than a typical Clean Water Act assessment.**, ~~'s unique setting, the Clean Water Act mandates may be handled somewhat differently than the typical situation.~~ In particular, the Hood Canal watershed is characterized by:

- Very few point sources that are regulated under the NPDES permitting system.
- **Significant public interest in potential impacts from** ~~The largest source of anthropogenic nitrogen loading may be~~ on-site septic systems, which are regulated through the Washington State Department of Health and not Ecology.
- **Potential impacts from forest conversion, air deposition, and other sources that might be considered minor in other waterbodies.**
- **Uncertainty around boundary effects from Admiralty Inlet and the degree to which nitrogen levels at this boundary can be considered natural conditions.**

Also it should be noted that **while the Hood Canal is listed on the 303(d) list of impaired waters in the state**, the Hood Canal project is not currently being managed as a Total Maximum Daily Load project. The ultimate management approach for nitrogen loading reductions (if found to be needed) may be different than the typical TMDL approach. Nevertheless, the basic needs of EPA and Ecology would be as described above.

Attachment A. Typical Model Documentation Requirements

The Model Development and Calibration Report should include the following elements:

- Model selection, capabilities, software/hardware requirements
- Historic period(s) selected for model development & evaluation
- Available data and quality assurance evaluations
- Boundary condition setup (e.g., groundwater, weather, rivers to be included)
- Selection of critical model output locations and dates (in consultation with policy team)
- Hydrodynamic evaluation – simulated vs measured conditions
- Water quality evaluation – simulated vs measured conditions
- Evaluation of uncertainty
- Future monitoring recommendations to reduce uncertainty

The Model Application Report should include the following elements:

- Assessment questions
- Baseline assumptions and design conditions
- Model simulation results
- Conclusions about assessment questions

The recent work of Ecology and Portland State University on the Spokane River offers a good example of this type of documentation:

Model Development Report

Berger, et al. “Upper Spokane River Model: Model Calibration, 2001.” January 2003

Berger, et al. “Review of Spokane River Model for Washington Department of Ecology”. January 2004.

Model Application Report

Cusimano, R. “Spokane River and Lake Spokane (Long Lake) Pollutant Loading Assessment for Protecting Dissolved Oxygen”. February 2004.